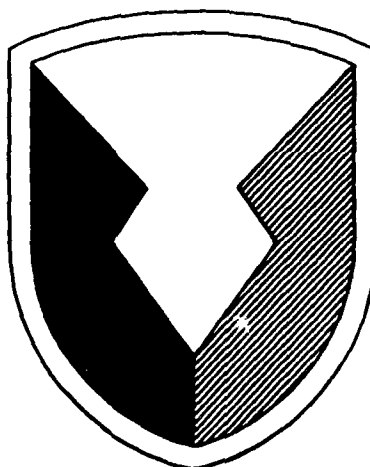


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TEST & EVALUATION COMMAND



FINAL REPORT
OF
MILITARY POTENTIAL TEST
OF THE
MODEL 3101 FIXED-WING INSTRUMENT TRAINER

DA PROJECT NO. NONE

USATECOM PROJECT NO. 4-5-1001-01

NOV 1964

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AVIATION TEST BOARD

FORT RUCKER, ALABAMA

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DETAILED DESCRIPTION OF MODEL 310I AIRPLANE AS TESTED

1. General. The Model 310I airplane is a low-wing, all-metal, tri-cycle-landing gear, twin-engine airplane. Each IO-470-U engine drives an 80-inch diameter, two-bladed, full-feathering, constant-speed D2AF34C52/80GFO propeller. The fuselage and tapered cantilever wings are separate semimonocoque structures. The 310I is certificated in the Standard-Normal Category by the Federal Aviation Agency (FAA), and the Approved Type Certificate is 3A10. The manufacturer's airplane serial number is 310I-0156.

2. Cockpit. Side-by-side seating is provided for the instructor pilot and student in individual, adjustable seats. Entrance to the cockpit is gained by a side door located on the right side of the fuselage or from the cabin area. Rudder pedals and a wheel-type flight control are provided for the instructor pilot and student. The instrument panel provides space for engine and flight instruments, avionic control heads and indicators, and electrical switches. A covered panel containing "push-to-reset" type circuit breakers is located on the left wall of the cockpit. A fuel selector for each engine is located in a fuel selector panel on the cockpit floor between the instructor and student pilot.

3. Cabin. Individual passenger seats are located in the cabin area behind the instructor pilot's and student pilot's seat. The seats are forward facing, adjustable fore and aft, reclining chairs. Folding arm rests are provided on all seats. Entry into the cabin is accomplished through a side door located on the right side of the fuselage. The cabin has provisions for lighting, heating, and ventilation. The cabin floors are carpeted and the walls and ceiling are fitted with soundproofed appointments. The combined cockpit and cabin area has the following dimensions:

Height - 49.5 inches (max.)

Width - 48.5 inches (max.)

Length - 132 inches (max.)

Volume - 129 cu. ft.

Incl 2

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4. Flight Controls. The 310I airplane has dual flight controls affording control of the aircraft from either the instructor pilot or student pilot's station. A rotary movement of the control wheel controls the aileron travel. Fore-and-aft movement of the control column positions the elevator. The rudder travel is controlled by a dual set of rudder pedals mounted on the cabin floor forward of the instructor and student pilot stations. The wing flap movement is electrically controlled by positioning the flap control lever mounted on the instrument panel. The ailerons and elevators are mechanically actuated through push-pull rods and closed-circuit cable systems terminating in bell cranks. The rudder is actuated by a closed-circuit cable system terminating in bell cranks. The aileron, elevator, and rudder trim-tab control wheels are located on the lower portion of the engine control pedestal. Mechanical systems consisting of closed-circuit cables and jack shafts transmit trim control movements to the trim tabs. Indicators adjacent to the trim-tab control wheels show the trim-tab position. The trim-tab control wheels are located with the axis of the wheel coincident with the maneuvering axis of the respective trim tab. Turning the aileron trim-tab control wheel clockwise gives a left wing-up attitude, and turning the wheel counter-clockwise gives a right wing-up attitude. A nose-up attitude is obtained by turning the elevator trim-tab control wheel downward, and turning the wheel upward gives a nose-down attitude. Turning the rudder trim-tab control wheel to the left provides a left rudder trim, and turning the wheel to the right provides a right rudder trim.

5. Engine. The 310I is powered by two IO-470-U engines. The IO-470-U is a direct-drive, wet-sump, horizontally-opposed, six-cylinder, air-cooled, fuel injection engine. The engine displacement is 471 cubic inches, and the compression ratio is 8.6 to 1. The rated takeoff and rated maximum continuous brake horsepower is 260 at 2625 r.p.m. The FAA Type Certificate number for this engine is 3E1. The oil capacity is 12 quarts.

6. Engine Cowling. The engine cowling consists of seven sections. To facilitate servicing the engine, a large and a smaller cowl section on each side of the engine hinges downward. A cowling nose ring, a top cowl panel incorporating the oil level filler access, and the lower engine cowl complete the cowling assembly.

7. Engine Cooling. Cooling air enters the engine compartment through the openings in the cowling nose ring. A down-draft cooling system directs this cooling air down and around the engine cylinders and out through the augmentor tubes underneath the engine nacelle.

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8. Propellers. The Model 310I is equipped with all-metal DA2F 34C52/80GFO, controllable, full-feathering, constant-speed, two-bladed propellers. The propeller is controlled by a governor mounted on the left forward side of the engine. Oil pressure acting on the blade-actuating piston changes the propeller blade angle to low pitch. The propeller counterweights rotate the propeller blades to a high-pitch angle. The governor regulates the oil pressure acting against the counterweights to position the propeller blades for a constant rotational speed selected by the pilot. A combination of the centrifugal force of the counterweights and force from an internal spring rotate the propeller blades to the feathered position when the oil pressure is relieved. A spring-loaded, high-pitch stop latch prevents the propeller from feathering when the airplane is on the ground and the engine is stopped. The latch is disengaged by centrifugal force when the propeller is rotating above 500 r.p.m. Feathering the propeller is accomplished by moving the cockpit pedestal-mounted propeller control lever rearward through the detent into the feathering range. Although unfeathering can be accomplished in flight by starting the engine with the control lever just forward of the feathering detent, a positive unfeathering system is installed to assist in the operation. This system consists of a nitrogen-charged accumulator, a special governor, and a hose running between the governor and the accumulator. The governor contains a spring-loaded check valve which is unseated while the propeller control lever is in any position except "FEATHER," thus permitting governor-pressurized oil to flow to and from the accumulator. When the propeller control lever is moved to the "FEATHER" position, the check valve is seated and oil under governor pressure is trapped in the accumulator and hose. As the propeller control lever is moved out of the "FEATHER" position, the trapped oil flows back through the governor to the propeller to unfeather it. The windmilling propeller makes it unnecessary to engage the starter for in-flight engine starting.

9. Fuel System. The fuel is contained in two integrally-sealed wet tip tanks and two rubberized fuel bladders located in each wing. The four tanks have a total usable fuel capacity of 150 US gallons. During normal operation each engine draws fuel from the adjacent main wing tip tank or auxiliary wing fuel cell. However, a system of fuel crossfeed lines permits either engine to consume fuel from the opposite main wing tip tank. Each fuel tank is filled through its own filler opening located in the upper wing surface. The openings are covered by flush-type filler caps. An individual two-speed electric boost pump is provided for each engine. High pressure is used for starting and provides for near maximum engine performance should the engine-driven pump fail. When necessary in high ambient temperatures, low pressure can be used for

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ground operation, take-off, climb, and landing. The fuel on-off valves are manually actuated from the cockpit by the fuel selector handles. Fuel quantity is measured by float-type transmitter units which transmit signals to the fuel gauges on the instrument panel.

10. Landing Gear System. The Model 3101 airplane is equipped with an electrically-retractable tricycle landing gear. The landing gear is operated through push-pull tubes by a reversible electric motor and actuator box under the front seat. The motor is controlled by a two-position landing gear switch located on the instrument panel. Limit switches automatically stop the retraction mechanism when the landing gear reaches its full-up or full-down position. The nose gear retracts rearward into the nose section. The main landing gear retracts inward into the wing wheel wells. With the landing gear in the UP position, the wheels are completely enclosed by fairing doors which are operated mechanically by the retraction and extension of the gear. Individual up-locks actuated by the retraction system lock the main gear in the UP position. No down locks are necessary since the over-center pivot of the linkage forms a geometric positive lock when the gear is fully extended. Landing gear position lights, located above and below the landing gear switch, indicate the fully extended or retracted position. When either or both throttles are retarded in flight below a preset engine manifold pressure, with the gear retracted, a warning horn will sound an intermittent note. A safety switch prevents accidental landing gear retraction on the ground. The landing gear may be lowered manually by a handcrank located in front of and between the front seats (figure 1). The crank, when engaged, drives the normal landing gear actuation system. Approximately 60 turns of the crank are required to lower the landing gear. The nose wheel is made steerable through spring-loaded cables connected to the rudder pedals.

11. Brake System. The main landing gear wheels are equipped with single-disc, hydraulically-actuated brakes. The brakes are actuated by individual master cylinders connected to the rudder pedals and operated as toe brakes. The hydraulic brake fluid reservoir is located in the forward baggage compartment. The parking brake is set by an automotive-type hand brake control located at the left side of the cabin, below the instrument panel. Setting the control actuates the student pilot's brakes. A cable from the brake handle is routed by pulleys to the rudder pedal brake links. A one-quarter turn of the hand brake control permits the control to go forward and releases the brakes.

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Figure 1. Handcrank for lowering landing gear.

12. Electrical Power Supply System. A 28-volt d.c. electrical system is the basic source of electrical power. Current for starting the engine is normally supplied from two 12-volt, 24 ampere-hour, wet-cell storage batteries installed in the wing, outboard of the left engine nacelle (figure 2). Two 28-volt engine-driven generators provide the electrical power. A plug-in receptacle in the left wing under the batteries is available in the event external power source is desired.

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Figure 2. Battery installation.

13. Heating and Ventilating System. A forced air heating and ventilating system provides controllable cabin heat and ventilation. Blower air is furnished until the aircraft is in flight and the landing gear is retracted, and then ram air replaces blower air. In addition to the air supplied to the cabin through the heater fresh-air system, a separate ducting system routes ram air to individual fresh air outlets near each seat. The outlets can be manually adjusted to control the quantity and direction of air flow. A spill vent in the rear of the cabin completes the air circulation system. A 35,000-B.t.u. combustion-type heater provides heat for the cabin and the windshield defroster.

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14. Basic Aircraft Data. (See figure 3 for general dimensions.)

Aircraft Serial No. 310I-0156

Aircraft Type Certification No. 3A10

Engine Serial No. (Left) 115315-4-U; (Right) 115314-4-U

Engine Type Certification No. 3E1

Areas.

Wing (total)	150 sq. ft.
Flaps (total)	22.9 sq. ft.
Ailerons (total)	13.4 sq. ft.
Tabs	0.6 sq. ft.
Horizontal tail (total)	54.3 sq. ft.
Elevators (incl. tabs)	22.1 sq. ft.
Vertical tail (incl. rudder)	26.1 sq. ft.
Rudder (incl. tab)	11.8 sq. ft.
Dorsal fin	5.0 sq. ft.

General Data.

Wing

Airfoil section (root)	NACA 23018
Airfoil section (tip)	NACA 23009
Span	36 ft. 10.8 in.
Root chord	84 in.
Tip chord	35.64 in.

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Mean aerodynamic chord	61.0 in.
Taper ratio	1.5
Dihedral (outboard)	5 degrees
Aerodynamic washout (outboard)	2 degrees
Aspect ratio	7.3

Flaps

Span (total)	17 ft. 6 in.
Chord	25 percent

Ailerons

Span (total)	11 ft. 6 in.
Chord	22 percent

Horizontal Tail

Airfoil section (root)	NACA 0009
Airfoil section (tip)	NACA 0006
Span	17 ft. 0 in.
Mean aerodynamic chord	41.1 in.
Taper ratio	1.7
Aspect ratio	5.2
Elevator mean aerodynamic chord	16.1 in.

Vertical Tail

Airfoil section (base)	NACA 0009
Airfoil section (tip)	NACA 0006

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Height	75 in.
Height (ground line)	9 ft. 11.2 in.
Mean aerodynamic chord	55.8 in.
Taper ratio	1.8
Aspect ratio (geometric)	1.4
Rudder mean aerodynamic chord	21.0 in.

Maximum Fuselage Area Cross Section

Height	4 ft. 10 in.
Width	4 ft. 4 in.

Landing Gear

Tread on main wheels	12 ft. 0 in.
Wheel base	9 ft. 9.6 in.

Clearances

Propeller to fuselage	15.5 in.
Propeller to ground (normal static position)	11.75 in.
Propeller to ground (flat struts and tires)	5.75 in.
Fuselage to ground (flat struts and tires)	25.8 in.

Control Surface Movements

Wing flaps (maximum)	35 degrees down
Ailerons	20 degrees up
	20 degrees down

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Rudder	25 degrees right
	25 degrees left
Elevator	16 degrees up
	15 degrees down

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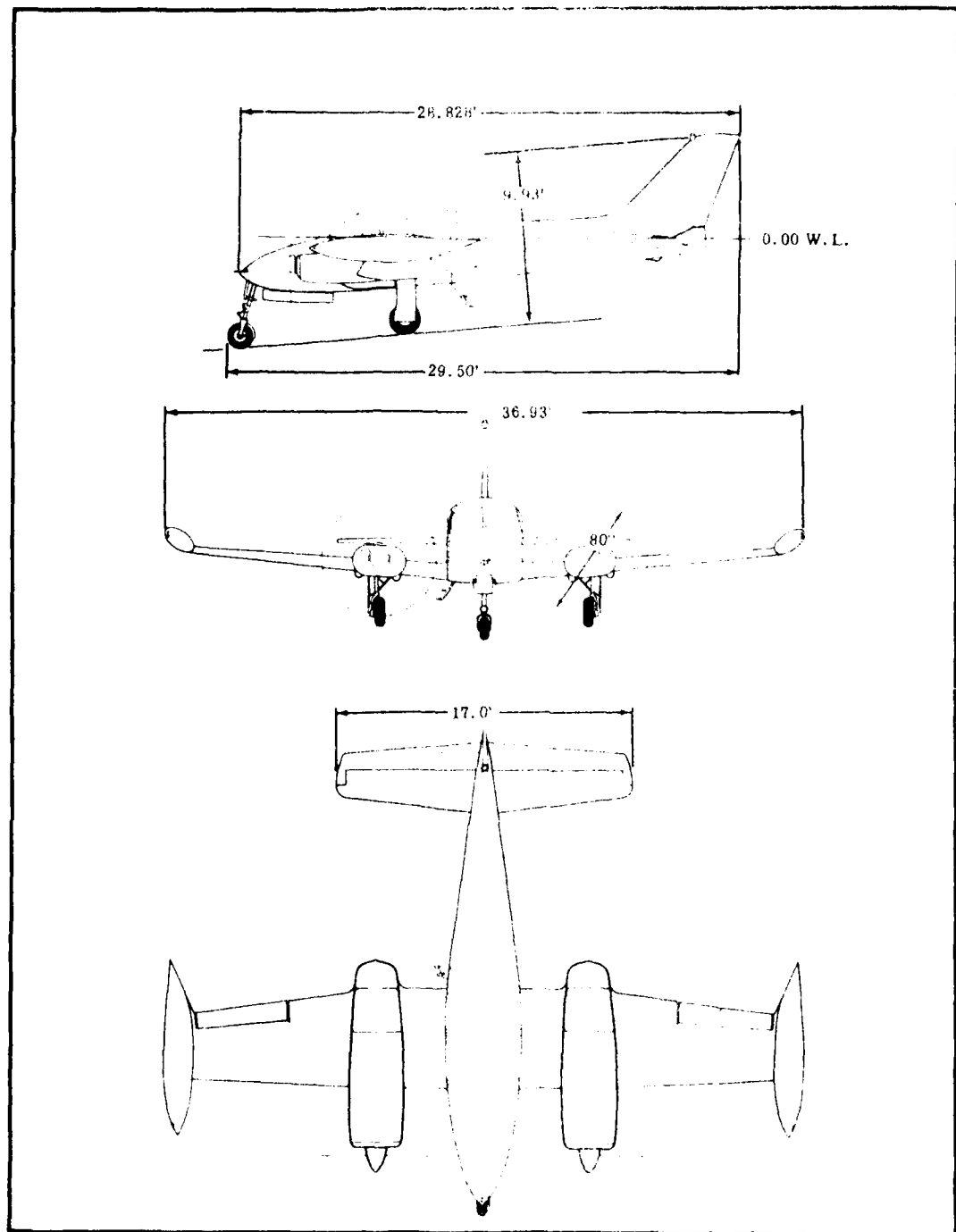


Figure 3. General dimensions of Model 3101 Airplane.

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CARBON MONOXIDE INVESTIGATION OF THE OFF-THE-SHELF
FIXED WING INSTRUMENT TRAINERS

1. INTRODUCTION.

The US Army Aeromedical Research Unit was requested to determine the carbon monoxide concentration within the crew/passenger compartment of the five Off-the-Shelf Fixed Wing Trainers.

The aircraft submitted for the evaluation were:

- a. Aero Commander 500B.
- b. Beechcraft Baron B-55-B.
- c. Cessna 310"1".
- d. Piper Aztec "B".
- e. Piper Aztec "C".

2. METHODS AND MATERIALS.

a. Equipment used:

(1) Mine Safety Appliance Company Universal Testing Kit Model 2 with carbon monoxide detectors.

(2) A 250cc air sample was forced through a vial of carbon monoxide sensitive crystals (part no. 47134) using a manually operated "piston type" pump (part no. 83498). In the presence of carbon monoxide, the normally pale yellow indicating crystals turn green. The concentration of carbon monoxide is determined by comparing the color of the exposed vial to a standard color chart (part no. 994200). Sensitivity of the indicating crystals is .001 to 0.1% carbon monoxide.

b. Method.

(1) Samples of the crew/passenger compartment air were collected while the aircraft operated at normal cruise with all vents closed and the heater on.

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(2) The air samples were collected at the heater duct opening to readily detect the slightest amount of carbon monoxide.

3. RESULTS AND CONCLUSIONS.

No carbon monoxide was detected in any of the five aircraft while operating at a cruise with all vents closed and the heater on.

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UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama

6
FINAL REPORT
OF
MILITARY POTENTIAL TEST
OF THE
MODEL 3101 FIXED-WING INSTRUMENT TRAINER.
DA PROJECT NO. NONE

USATECOM PROJECT NO. 4-5-1001-01

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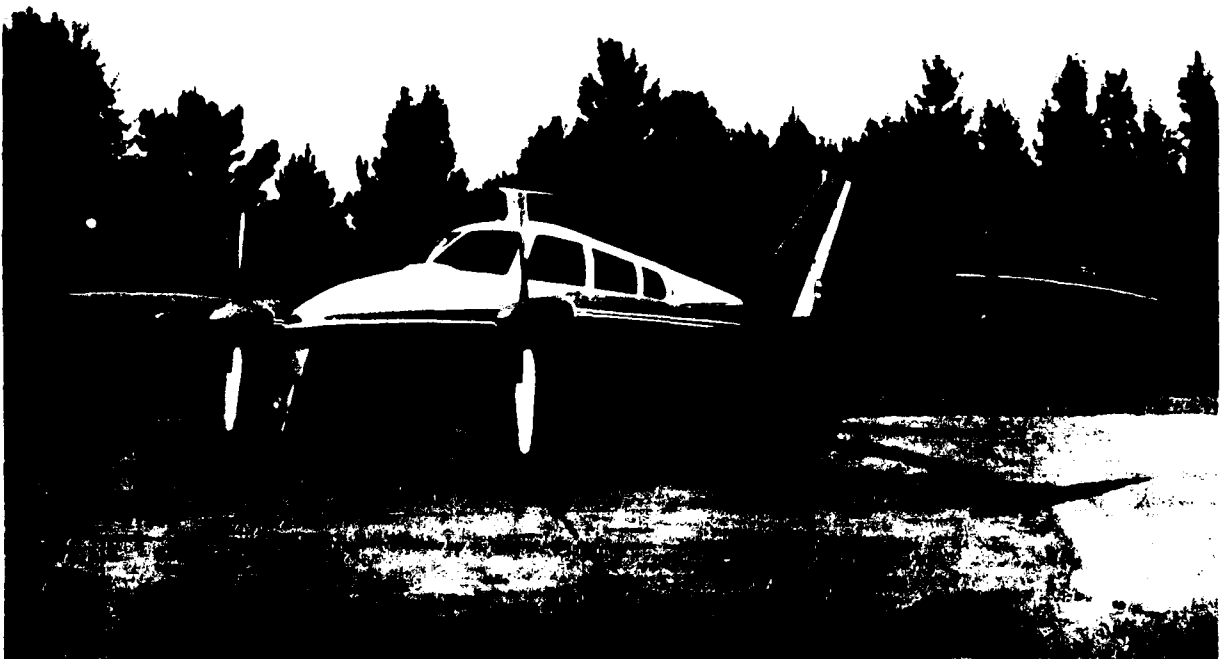
Raymond Johnson
for: A. J. RANKIN
Colonel, Armor
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ABSTRACT

✓ The Military Potential Test of the Model 310I Fixed-Wing Instrument Trainer was conducted by the US Army Aviation Test Board during the period 1 September to 21 October 1964 at Fort Rucker, Alabama. Flight under actual and simulated instrument conditions and flight demonstrations to personnel representing the US Army Aviation Center and the US Army Aviation School were conducted during the test period. It was found that the Model 310I as changed by the technical proposal will not meet all of the requirements contained in the Model Specification. It was recommended that a confirmatory test be performed on the initial production airplane if the Model 310I airplane is selected as a fixed-wing instrument trainer. ✓

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UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama

FINAL REPORT OF
MILITARY POTENTIAL TEST OF THE
MODEL 310I FIXED-WING INSTRUMENT TRAINER

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UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama 36362

USATECOM PROJECT NO. 4-5-1001-01
REPORT OF MILITARY POTENTIAL TEST
OF THE MODEL 310I
FIXED-WING INSTRUMENT TRAINER

SECTION 1 - GENERAL

1.1. REFERENCES.

A list of references is contained in appendix I.

1.2. AUTHORITY.

1.2.1. Directive.

Letter, AMSTE-BG, US Army Test and Evaluation Command, 29 October 1964, subject: "Test Directive for USATECOM Project No. 4-5-1001-01, Military Potential Test of Fixed Wing Instrument Trainer Aircraft."

1.2.2. Purpose.

To determine whether the "off-the-shelf" Model 310I airplane fulfills the Model Specifications for fixed-wing instrument trainers (reference 2).

1.3. OBJECTIVES.

To determine:

- a. Specified physical characteristics.
- b. Specified performance.
- c. The adequacy of the electronics configuration as proposed.

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1.4. RESPONSIBILITIES.

The US Army Aviation Test Board (USAAVNTBD) was responsible for developing, preparing, and publishing the plan of test and the report of test. Assistance during the test was provided by the US Army Aviation School (USAAVNS). Final approval of the plan and report of test is the responsibility of the US Army Aviation Materiel Command (USAAVCOM).

1.5. DESCRIPTION OF MATERIEL.

The proposed Model 310I instrument trainer airplane is a low-wing, all-metal, tricycle-landing gear twin-engine airplane. The fuselage and tapered cantilever wings are separate semimonocoque structures. The airplane is powered by two IO-470-U direct-drive, wet-sump, horizontally-opposed, six-cylinder, air-cooled, fuel injection engines. The rated takeoff and maximum continuous brake horsepower is 260 at 2625 r.p.m. Each engine drives an 80-inch diameter, two-bladed, full-feathering, constant-speed propeller. The propellers are equipped with a blade unfeathering system. The cockpit provides individual, adjustable, side-by-side seats for the instructor and student pilot. Individual forward-facing passenger seats are located in the cabin area behind the instructor pilot's and student pilot's seat. The fuel capacity is 150 US gallons. The gross weight of the proposed instrument trainer airplane is 5150 pounds.

1.6. BACKGROUND.

1.6.1. In June 1962, the USAAVNS submitted to the Commanding General, US Continental Army Command (USCONARC), a requirement for a commercially produced, "off-the-shelf," fixed-wing instrument trainer to replace the tactical airplanes presently used by USAAVNS for instrument training. In February 1963, the Director of Army Aviation, Office, Deputy Chief of Staff for Operations (DCSOPS), submitted a Statement of Materiel Requirements to the Commanding General, US Army Materiel Command (USAMC), for an "off-the-shelf" fixed-wing instrument trainer. A two-step procurement program was established. The Model Specification, which was revised June 1964, accompanied the Request for Technical Proposals (Step One for the Invitation for Bid) which was prepared by the USAAVCOM and mailed to industry 16 July 1964. Each bidder was required to submit a written technical proposal and one unit of the version of the aircraft on which it proposed to submit a bid. The Step Two of the competition will be confined to the bidders whose airplanes and technical proposals are found acceptable. The second step consists of a formal procurement in which bid prices will be submitted.

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1.6.2. A Model 310I test airplane possessing a Federal Aviation Agency (FAA) Standard-Normal Category Certificate was delivered to the USAAVNTBD for evaluation on 1 September 1964.

1.7. FINDINGS.

The Model 310I test airplane as changed by the technical proposal will not meet all of the requirements contained in the Model Specification (appendix II).

1.8. CONCLUSION.

The Model 310I airplane will not meet all of the requirements contained in the Model Specification.

1.9. RECOMMENDATION.

It is recommended that a confirmatory test be performed on the initial production airplane if the Model 310I airplane is selected as a fixed-wing instrument trainer.

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SECTION 2 - DETAILS AND RESULTS OF SUB-TESTS

2.0. INTRODUCTION.

2.0.1. During the period 1 September 1964 to 21 October 1964, the Model 310I test airplane underwent a 25- to 50-hour flight test program conducted by the US Army Aviation Test Board (USAAVNTBD), at Fort Rucker, Alabama.

2.0.2. Flight under actual and simulated instrument conditions and flight demonstrations to personnel representing the US Army Aviation Center (USAAVNC) and the US Army Aviation School (USAAVNS) were conducted during the test period.

2.1. PHYSICAL CHARACTERISTICS.

2.1.1. Objective.

To determine the physical characteristics of the Model 310I test airplane as contained in paragraphs 1.1.1, 3.2 - 3.4, 3.6, 3.7, and 3.9 - 3.11 of the Model Specification (appendix II).

2.1.2. Method.

2.1.2.1. The physical characteristics listed in Model Specification paragraph 1.1.1 were determined by visual study.

2.1.2.2. Determination of the physical characteristics listed in Model Specification paragraphs 3.2, 3.3, and 3.4 was made by measuring the airplane and weighing it with full oil and with fuel drained. Weight and balance computations were made for the proposed gross weight.

2.1.2.3. The physical characteristics listed in Model Specification paragraph 3.6 were determined by visual and physical studies. Instrument panel cutouts were not used since the installed panel was essentially the panel proposed.

2.1.2.4. The requirements for interior and exterior lighting outlined in the Model Specification paragraph 3.7 were checked during night flights. The rotating beacon was checked for conformity with paragraph 3.705, Civil Aeronautics Manual 3.

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2.1.2.5. The heater was operated and an analytical study was made based on the Model Specification requirement paragraph 3.9.1 and on the rated output of the heater.

2.1.2.6. The aircraft furnished for the test was equipped with deicing and anti-icing equipment. The equipment was operated in flight and on the ground, and a study was made from the description of the system in the FAA-approved Flight Manual and Maintenance Manual to determine conformity with the provisions of Model Specification paragraph 3.9.2.

2.1.2.7. Oxygen equipment was provided with the test aircraft. The equipment was operated, and a study was made of the descriptive material of the equipment found in the FAA-Approved Flight Manual and Maintenance Manual to determine if the equipment offered was capable of meeting Model Specification paragraph 3.9.3.

2.1.2.8. The area for stowage was measured and photographed to determine whether the space provided met the provisions of Model Specification paragraph 3.10.

2.1.2.9. A study was made of the publications that accompanied the test aircraft to determine whether the requirements of Model Specification paragraph 3.11 were met.

2.1.3. Results.

2.1.3.1. General Description, paragraph 1.1.1, Model Specification:

2.1.3.1.1. The Model 310I test airplane was equipped with individual side-by-side seating for a student and instructor pilot in the cockpit. Immediately to the rear in the cabin area, individual side-by-side seats were provided for two students. (See figure 1.)

2.1.3.1.2. Dual side-by-side flight controls were provided in the cockpit.

2.1.3.1.3. The Model 310I test airplane was powered by two IO-470-U reciprocating engines. Each engine drove a two-bladed, full-feathering, constant-speed D2AF34C52/80GFO propeller. A positive propeller unfeathering system was incorporated.



Figure 1. Seating arrangement.

2.1.3.1.4. The Model 310I test airplane featured an all-metal semi-monocoque construction and was equipped with electrically retractable tricycle landing gear.

2.1.3.2. Paragraph 3.2, Model Specification: The basic weight of the test airplane was 3455 pounds. This weight did not include all of the equipment required by paragraph 3.9 and the electronic equipment listed in appendix II of the Model Specification, which were not installed on the test airplane. No deletions were made from the basic weight for items installed on the test aircraft which were not required by the Model Specification. The weight analysis in the technical proposal gave the basic weight of the proposed aircraft as 3406 pounds. This figure could not be substantiated due to the impossibility of obtaining exact weights of all the items in question, and particularly for components permanently installed.

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2.1.3.3. Paragraph 3.3, Model Specification: The center-of-gravity (c.g.) range was 38.2 inches (forward c.g. limit) to 42.7 inches (aft c.g. limit). No restrictions to mission payload or utility arose from constraints relating to the c.g. range.

2.1.3.4. Paragraph 3.4, Model Specification: In addition to fuel and oil necessary to accomplish the endurance mission (5.0 hours at 65% power at 7500 ft. MSL), the useful load of the test airplane was 939 pounds. The technical proposal presented a figure of 900 pounds of useful load for the proposed trainer.

2.1.3.5. Paragraph 3.6.2.1, Model Specification: The Model 310I test airplane featured an all-metal semimonocoque construction of the airframe.

2.1.3.6. Paragraph 3.6.2.2, Model Specification: The cabin interior arrangement provided individually adjustable side-by-side front seats. Two additional seats were provided immediately to the rear of the front seats. The seating arrangement permitted the exchange of the seating of the three students during flight. Shoulder harnesses were not provided in the test airplane; however, the item was listed in the technical proposal.

2.1.3.7. Paragraph 3.6.2.2.1, Model Specification: The fire extinguisher (4210-555-8837) and first-aid kit (9-196-650) are Government Furnished Aircraft Equipment (GFAE) and, therefore, were not present on the test aircraft.

2.1.3.8. Paragraph 3.6.2.3.1, Model Specification: The test airplane was equipped with dual flight controls including rudder pedals with toe-type brakes (figure 2). The rudder pedals were not adjustable; however, the technical proposal provided for adjustable pedals.

2.1.3.9. Paragraph 3.6.2.3.2, Model Specification: The rudder, elevator, and aileron trim-tab control wheels were located on the left side and in the lower portion of the engine control pedestal. These controls were accessible to both the student and instrument pilot.

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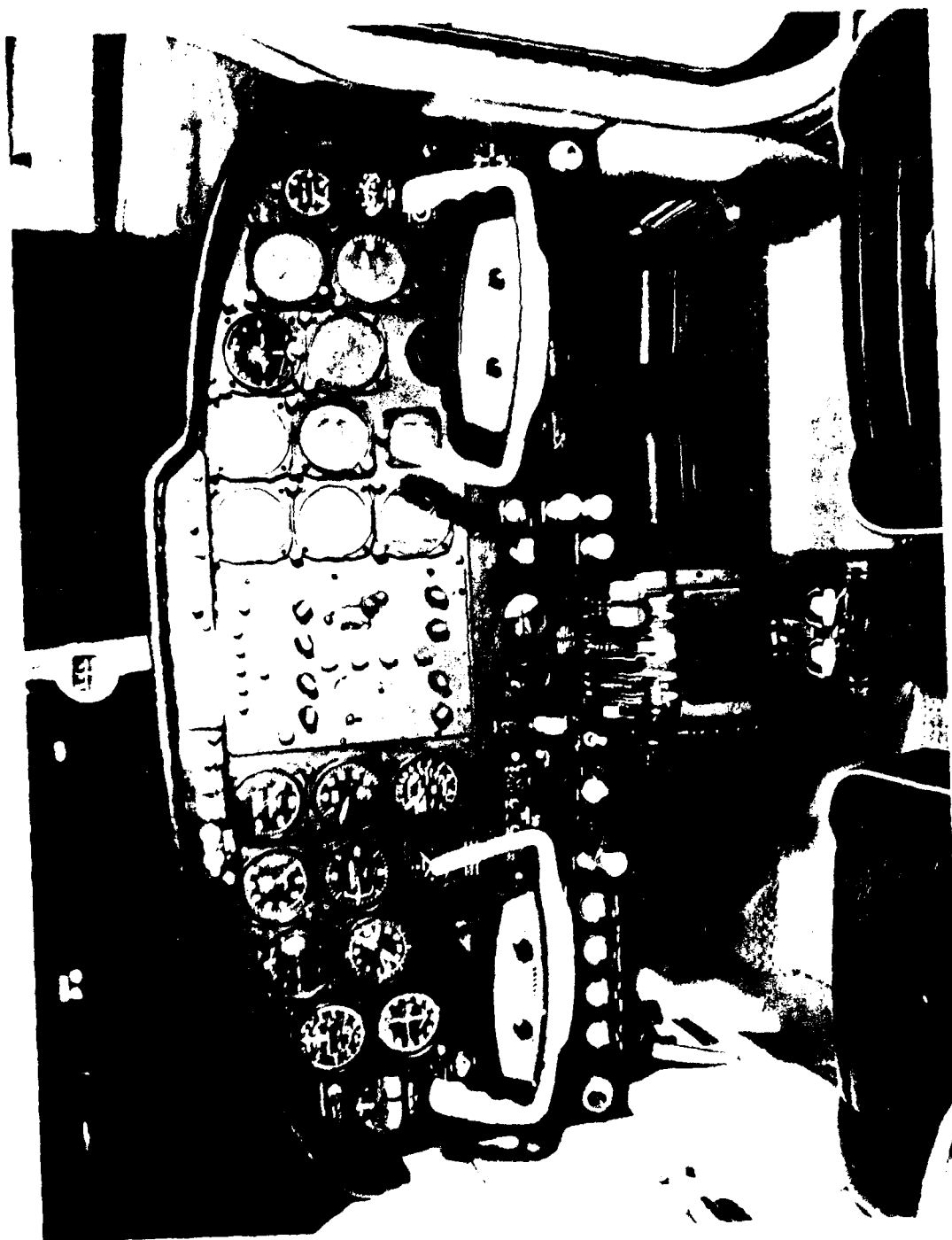


Figure 2. Model 101 dual flight controls, engine controls, and emergency controls.

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2.1.3.10. Paragraph 3.6.2.3.3, Model Specification: The engine control levers were mounted on the engine control pedestal located in front of, and between, the student and instructor pilot. The engine control levers controlled the throttle, propeller, fuel mixture, and alternate air. A friction lock wheel, located on the right side of the engine control pedestal, locked the engine control levers in any desired position. These control levers were easily accessible to the student and instructor pilot.

2.1.3.11. Paragraph 3.6.2.3.4, Model Specification: A positive two-axis control surface lock which could be installed on the student pilot's flight control column was provided with the test aircraft. No provision for a rudder lock was furnished.

2.1.3.12. Paragraph 3.6.2.4.1, Model Specification: The test aircraft was delivered with a factory custom instrument panel which conformed to the provisions of the Model Specification. The instrument panel was described in the technical proposal and had the proper arrangement of instruments. The two proposed attitude indicators had separate power sources.

2.1.3.13. Paragraph 3.6.2.4.2, Model Specification: The engine instruments were readable by both student and instructor pilot.

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2.1.3.14. Paragraph 3.7.1, Model Specification: All of the instruments on the test aircraft were individually lighted, and were compatible with night and instrument flight rule operations. A secondary lighting system consisting of red and white panel flood lights was located in the forward end of the overhead console panel. This panel was located on the cabin ceiling above the front seats. The flood lights were controlled by separate rheostat switches on the console panel. The front dome light was located to the rear of the rheostat switches and was controlled by a slide switch adjacent to it. A similar dome light was provided for the rear seats. Additionally, a white light mounted internally within the bottom section of the flight control wheels, and operated by a rheostat switch on the control wheel, furnished light on charts and note paper held on the pilot's lap.

2.1.3.15. Paragraph 3.7.2, Model Specification: The Model 310I test airplane was equipped with a rotating anticollision beacon faired into the top edge of the vertical stabilizer. The installed beacon met the provisions of the FAA requirements as set forth in paragraph 3.705 of the Civil Aeronautics Manual 3 (reference 5).

2.1.3.16. Paragraph 3.9.1, Model Specification: A 35,000-B.t.u. combustion-type cabin heater was installed in the test airplane. Existing climatic conditions precluded actual tests to determine the capability of the heater to meet the criteria of the Model Specification. However, using the ventilating air flow rate and available combustion heater information (reference 4), the installed heater should amply fill the requirements of the Model Specification.

2.1.3.17. Paragraph 3.9.2, Model Specification: The Model 310I test airplane was equipped with FAA-approved wing deicing and propeller anti-icing equipment. The pneumatic deicer boots for the wing and tail surfaces and the electric propeller anti-icing equipment were operated successfully. The deicing and anti-icing equipment was capable of continuous operation for the flight endurance of the aircraft. The test airplane was equipped with pilot-controlled, heated alternate air for each engine induction system.

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2.1.5.18. Paragraph 3.9.3, Model Specification: FAA-approved oxygen equipment was installed in the Model 3101 test airplane. Oxygen was available to each occupant through individual outlets. The flight manual stated that the equipment would provide 2.5 hours' duration for four persons at 15,000 feet altitude, and this figure was substantiated in flight. This system did not employ liquid oxygen.

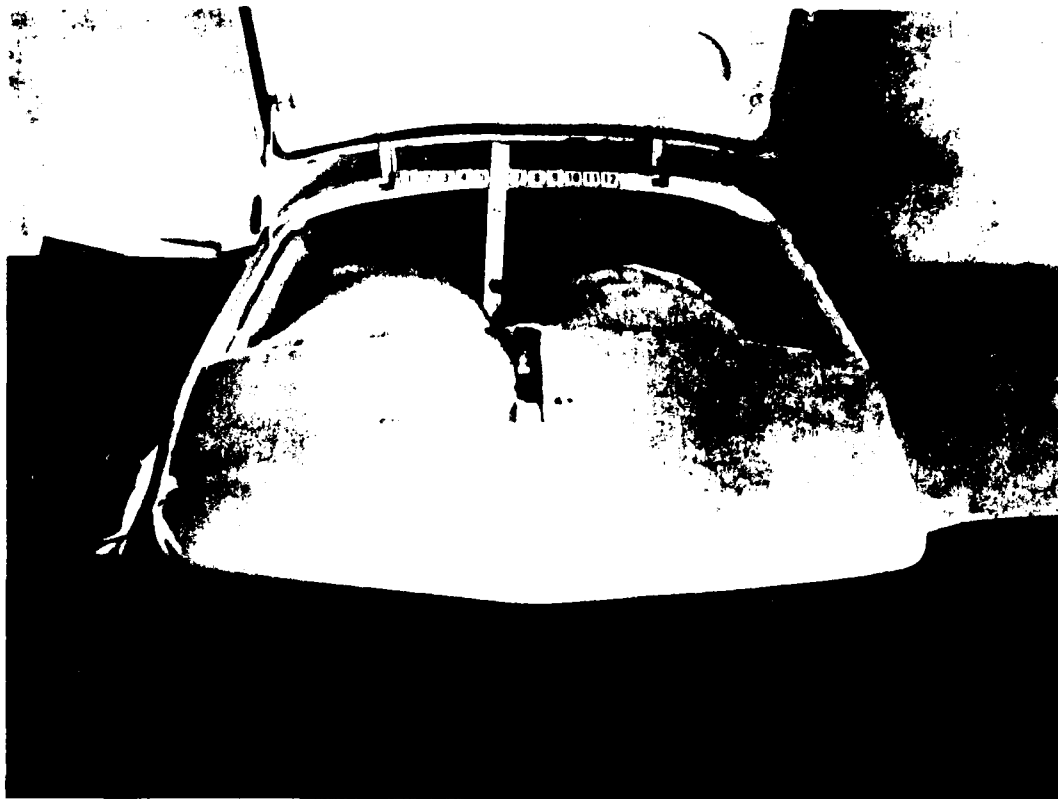


Figure 3. Baggage compartment in engine nacelle.

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2.1.3.19. Paragraphs 3.10.1 and 3.10.2, Model Specification: The test airplane had the required baggage space for a minimum of 100 pounds of personal baggage. A baggage compartment in each engine nacelle provided approximately 10 (total) cubic feet of baggage space (figure 3). A door 25 inches wide by 24 inches high provided access to each nacelle baggage compartment. The compartments were placarded for a weight limit of 120 pounds. There was ample storage space within the cabin for maps, charts, computers, and one TM 11-2557 (Jeppesen Case). A stowage area behind the rear seat measured 43 inches wide (average), 34 inches high (average), and 22.5 inches long (figure 4). The weight capacity of this area was placarded for a weight limit of 200 pounds. An adjacent area 40 inches wide, 15 inches high, and 14.5 inches long was placarded for 80 pounds. Outside access to both areas was by a side baggage door which measured 19.5 inches wide and 21 inches high (figure 5).



Figure 4. Stowage area behind rear seat

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Figure 5. Access by side baggage door

2.1.3.20. Paragraph 3.11, Model Specification: The Model 310I test airplane was delivered with an FAA-approved airplane flight manual and a maintenance and parts manual.

2.1.4. Analysis.

Not applicable.

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2.2. PERFORMANCE.

2.2.1. Objective.

To determine the performance characteristics of the Model 310I test airplane as related to the requirements specified in paragraph 3.5 of the Model Specifications.

2.2.2. Method.

2.2.2.1. The test airplane was flown at the gross weight outlined by the useful load requirement (paragraph 3.4, Model Specification), and tests were conducted to determine the cruise true airspeed (TAS), endurance, single-engine service ceiling (FAA requirement), and minimum safe single-engine speed (V_{mc}). Ballast was used to bring the gross weight of the test airplane up to the proposed Standard-Utility Category gross weight of 5150 pounds. Data were tabulated in the National Aeronautical Space Administration Standard Day format.

2.2.2.2. The airspeed indicator from the test aircraft was calibrated. The airspeed position errors were obtained by the ground speed course method outlined in reference 3.

2.2.2.3. The factory engine cruise control chart and procedures outlined in the flight manual were used to determine the power settings for a series of stabilized level flight, 65-percent, cruise power runs. The data recorded were corrected to standard-day conditions.

2.2.2.4. The endurance data were obtained by use of the installed flow meters and verified by controlled flight profiles. The power was in accordance with recommended power charts and procedures. The mixture controls were set for best economy.

2.2.2.5. The single-engine service ceiling was determined by a series of saw-tooth climbs to substantiate the factory-recommended single-engine climb schedule. Using the climb schedule, climb data were obtained and reduced to standard-day conditions.

2.2.2.6. The minimum safe single-engine speed was investigated using the procedures and conditions described in paragraph 3.111, Civil Aeronautics Manual 3 (reference 5).

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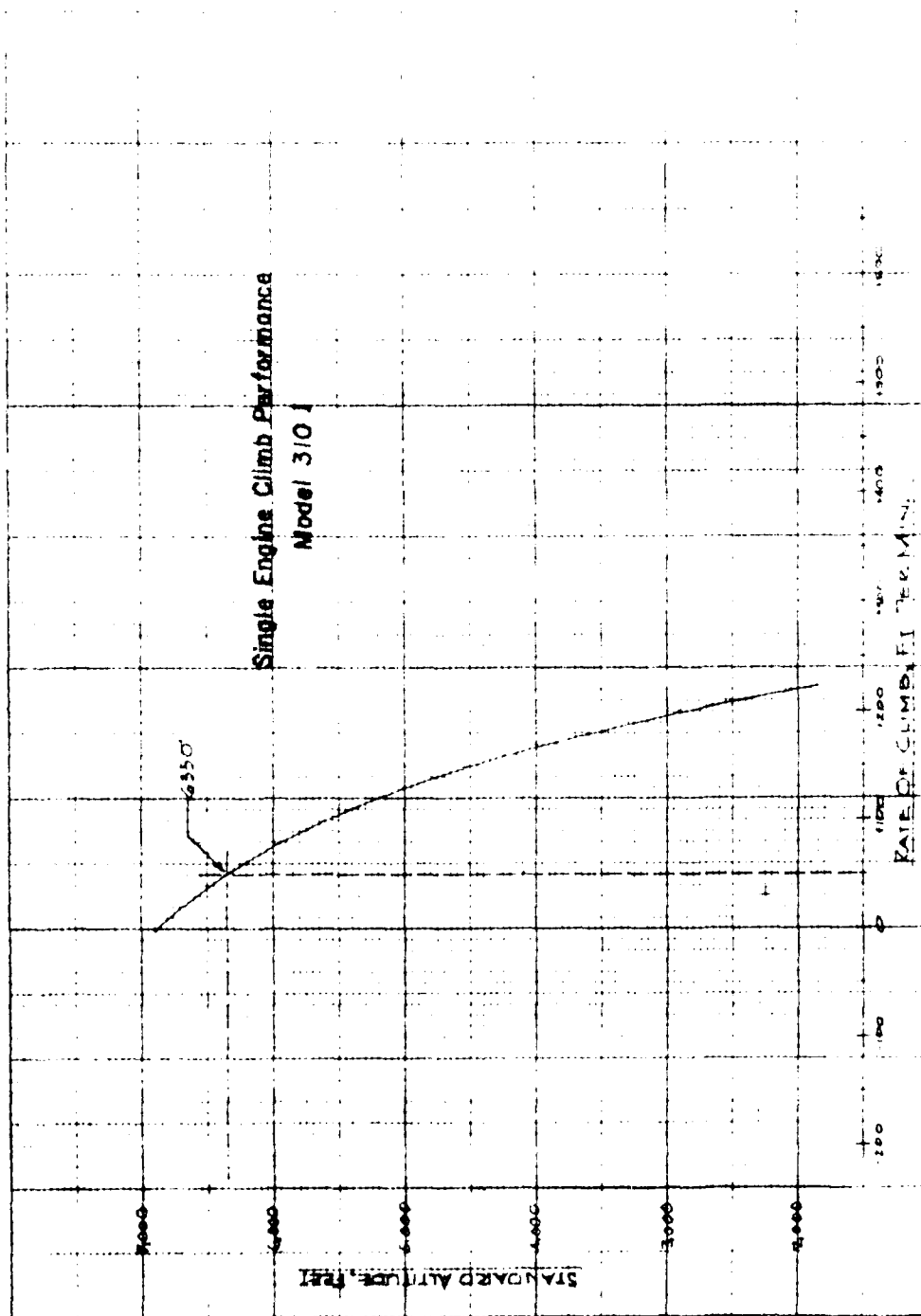


Figure 6

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2.2.3. Results.

2.2.3.1. The cruise speed at 65 percent power, 7500 feet mean sea level was 178 knots TAS.

2.2.3.2. The Model 310I test airplane consumed an average of 23.6 gallons of fuel per hour at 7500 feet altitude using a 65-percent best economy engine power setting. The test airplane basic weight was 3455 pounds. With the engine oil (48 pounds) and the 900-pound useful load required by the Model Specification, 747 pounds of fuel (124.5 gallons) may be added to meet the proposed Standard-Utility Category gross weight of 5150 pounds. With this quantity of fuel, the test airplane will operate at the prescribed altitude and power settings for 5.27 hours. However, the technical proposal basic weight of 3406 pounds for the instrument trainer will allow 780 pounds (130 gallons) for fuel. This quantity of fuel will give the proposed instrument trainer an endurance figure of 5.5 hours based on the fuel consumption rate of the test airplane engines.

2.2.3.3. The Model 310I test airplane had a single-engine service ceiling (climb rate of 50 f. p. m.) of 6350 feet (see figure 6).

2.2.3.4. The minimum safe single engine speed (V_{mc}) at sea level was 70.3 knots calibrated airspeed (CAS).

2.2.4. Analysis.

Not applicable.

2.3. ELECTRONICS CONFIGURATION.

2.3.1. Objective.

To study the technical proposal and determine the adequacy of the electronics configuration as related to paragraph 3.8 of the Model Specification.

2.3.2. Method.

2.3.2.1. The technical proposal was studied with regard to electronic equipment as listed in appendix II, Model Specification. Where practical, the installation plans of the above items were studied.

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2.3.2.2. The proposed location of the electronics installation was checked visually for accessibility and readability of the electronic controls.

2.3.2.3. A study was made to ascertain the conformity of the electronic control locations with paragraph 3.8.3, Model Specification.

2.3.3. Results.

2.3.3.1. Paragraph 3.8.1, Model Specification: The electronic configuration proposed for the instrument trainer was in accordance with appendix II, Model Specification.

2.3.3.2. Paragraph 3.8.2, Model Specification: The electronic controls were easily accessible and readable to the student and instructor pilot (see figure 2).

2.3.3.3. Paragraph 3.8.3, Model Specification: The electronic controls proposed were front panel mounted. No overhead control panel installation was proposed.

2.3.4. Analysis.

Not applicable.

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SECTION 3

APPENDICES

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APPENDIX I

LIST OF REFERENCES

1. Plan of Test, USATECOM Project No. 4-5-1001-01, "Military Potential Test of 'Off-the-Shelf' Airplanes as Fixed Wing Instrument Trainers," USAAVNTBD, dated 18 November 1964.
2. Letter, AMSTE-BG, USATECOM, 29 October 1964, subject: "Military Potential Test of Fixed Wing Instrument Trainer Aircraft," with inclosures.
3. AF-TR-6273, Flight Test Engineering Manual, Major Russel M. Herrington and Captain Paul E. Shoemaker, May 1951 (revised January 1953).
4. Kent's Mechanical Engineering Handbook (Power), Revised 1957.
5. Civil Aeronautics Manual 3, Airplane Airworthiness, Normal, Utility, and Acrobatic Categories, May 1962.
6. Model 310I Service Manual, Cessna Aircraft Company, 1 November 1963.
7. Model 310I Owner's Manual, Cessna Aircraft Company, 16 January 1964.
8. Model Specification, Fixed Wing Instrument Trainer, Revised 26 June 1964, with Flight Instrumentation Appendix I and Table E, Appendix II.
9. Letter, SMOSM-PAIF-1, USAAVCOM, 16 July 1964, subject: "Invitation for Bid No. AMC(T)-23-204-64-459 (Step One)."
10. Technical Proposal CMP-1104, Cessna Aircraft Company, 28 August 1964.

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APPENDIX II

COMPARISON WITH MODEL SPECIFICATIONS

<u>Model Specification</u>	<u>Proposed Model 310I Trainer Airplane Meets Mod Specs</u>	<u>Remarks</u>
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Fixed-Wing Instrument Trainer

1. SCOPE

1.1 Scope. This specification covers the essential requirements for an instrument training airplane capable of performing the missions specified in 1.2

1.1.1 Designation and General Description

Army Model Designation	Not yet assigned	
Number of Crew	1 Pilot (instructor)	Yes
Number of Passengers	3 Students	Yes
Flight Controls	Dual, side by side	Yes
Propulsion	Two recip- rocating engines, feathering and positive un- feathering propellers	Yes

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<u>Model Specification</u>	<u>Proposed</u> Model 3101 Trainer Airplane Meets Mod Specs	<u>Remarks</u>
Configura- tion and Construction	All metal with retract- able tricycle landing gear	Yes

1.2 Mission. The primary mission in which this airplane will be employed is the training of military pilots in instrument flying, in both day and night instrument flight rule operations.

1.2.1 Secondary Mission. Twin Engine Transition Trainer for single engine rated aviators.

1.3 Performance Information. Those items of performance stated as requirements herein which are not included in the FAA approved flight manual are subject to verification by the U. S. Army.

2. APPLICABLE DOCUMENTS

2.1 The applicable documents shall be those necessary to fulfill the requirements of paragraph 3.10, Federal Aviation Agency Certification.

3. REQUIREMENTS

3.1 Federal Aviation Agency Certification. The airplane shall have a Part 3 (effective as of the

Yes

Test airplane
had FAA Stand-
ard Normal

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<u>Model Specification</u>	Proposed Model 3101 Trainer Airplane Meets Mod <u>Specs</u>	<u>Remarks</u>
date of issuance of the IFB) standard airworthiness certificate for instrument flight operations, issued by the Federal Aviation Agency in the Utility category.		Category Certificate.
GFAE (electronics), contractor installed, shall be operationally verified by FAA.	Yes	
3.2 <u>Basic Weight</u> . The basic weight of the airplane shall include all required installed equipment including the items in Section 3.9 and the Electronic Equipment as stated in appendix II.	Yes	Basic weight of test airplane did not include required in- stalled equip- ment.
3.3 <u>Center-of-Gravity Range</u> . No restrictions to mission payload or utility shall arise from constraints relating to center-of-gravity range, i. e. indiscriminate loading not to exceed useful load.	Yes	
3.4 <u>Useful Load</u> . The useful load shall be a minimum of 900 lbs. of payload in addition to fuel and oil necessary to accomplish the endurance mission of paragraph 3.5.1.	Yes	
3.5 <u>Required Performance</u>		
3.5.1 <u>ICAO Standard Day Performance</u> .		
(at certificated gross weight)		

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<u>Model Specification</u>		Proposed Model 3101 Trainer Airplane Meets Mod Specs	<u>Remarks</u>
Cruise Speed (Minimum)	150 knots True Air Speed (TAS) at 65% Power at 7500 ft. Mean Sea Level (MSL)	Yes	
Endurance (Minimum)	5 hours at 65% Power at 7500 ft. MSL.	Yes	
Single Engine Service Ceiling (minimum) - 7000 ft. MSL		No	Single-engine service ceiling was 6350 feet.
Minimum Safe Single Engine Speed at Sea Level, not to exceed 80 knots		Yes	
<u>3.6 Aircraft Structure</u>			
3.6.1 <u>Landing Gear.</u> The landing gear shall be nose-wheel type tri- cycle configuration and shall be retractable. The nose wheel shall be steerable.		Yes	
<u>3.6.2 Airframe</u>			
3.6.2.1 Construction shall be all metal.		Yes	
3.6.2.2 <u>Interior Arrangement.</u> Individual side-by-side adjustable		Yes	

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<u>Model Specification</u>	<u>Proposed Model 310I Trainer Airplane Meets Mod Specs</u>	<u>Remarks</u>
front seats for the student on the left and the instructor on the right. Two additional seats immediately to the rear to accommodate two additional students. Seating arrangement must permit exchange of the three (3) students in flight.		
Shoulder harnesses shall be required for the front seats only.	Yes	
3.6.2.2.1 One (1) fire extinguisher and one (1) first aid kit shall be installed and shall be accessible in flight. (See appendix III.)	Yes	
<u>3.6.2.3 Flight and Engine Controls</u>		
3.6.2.3.1 Dual flight controls to include adjustable rudder pedals with toe-type brakes.	Yes	
3.6.2.3.2 In-flight trim controls for elevator, aileron, and rudder are required and shall be easily accessible to both the student and instructor.	Yes	
3.6.2.3.3 Engine controls shall be easily accessible to both the student and instructor.	Yes	

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<u>Model Specification</u>	Proposed Model 310I Trainer Airplane Meets Mod Specs	<u>Remarks</u>
3.6.2.3.4 Positive control surface locks will be provided for ramp use.	No	No positive rudder control surface locks were provided.
3.6.2.4 <u>Instrumentation</u>		
3.6.2.4.1 The instrument panel shall have dual instrumentation incorporating the "T" panel arrangement depicted in appendix I. Further, the two (2) attitude indicators shall have separate power sources.	Yes	
3.6.2.4.2 Engine instruments shall be readable by both student and instructor pilot.	Yes	
3.7 <u>Lighting</u>		
3.7.1 Cockpit and instrument lighting are required for night and instrument flight rule operations. (Fluorescent and/or red flood lighting not acceptable as primary lighting of instrument panel.)	Yes	
3.7.2 The aircraft shall have rotating beacon(s) per FAA requirements.	Yes	
3.8 <u>Electronic Equipment</u>		
3.8.1 Electronics shall be in accordance with appendix II.	Yes	
3.8.2 Controls shall be easily accessible and readable to the student and instructor.	Yes	

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	Proposed Model 3101 Trainer Airplane Meets Mod Specs	
<u>Model Specification</u>	<u>Specs</u>	<u>Remarks</u>
3.8.3 Electronics controls shall be front panel mounted wherever possible. Overhead control panels are not acceptable.	Yes	
3.9 <u>Aircraft Systems</u>		
3.9.1 <u>Cabin Heating.</u> The aircraft shall have a heating system capable of maintaining a minimum of +40°F. cabin temperature with -25°F. outside air temperature.	Yes	
3.9.2 <u>Deicing Equipment.</u> Lightweight deicing and anti-icing equipment shall be installed on the aircraft as certificated. Deicing equipment must be capable of continuous operation for flight endurance of the aircraft.	Yes	
3.9.3 <u>Oxygen Equipment.</u> Equipment for four (4) persons for a minimum of 1.5 hours duration at 15,000 feet MSL. A liquid oxygen system is not acceptable.	Yes	
3.10 <u>Stowage</u>		
3.10.1 Baggage space shall be provided for a minimum of 100 lb. of personal baggage.	Yes	
3.10.2 Storage space within the cabin shall be provided for maps, charts, computers, and one (1) TM 11-2557 (Jeppesen Case).	Yes	

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<u>Model Specification</u>	<u>Proposed Model 3101 Trainer Airplane Meets Mod Specs</u>	<u>Remarks</u>
3.11 <u>Manuals</u>		
3.11.1 The aircraft shall be furnished with a Flight Operator's Manual in accordance with FAA regulations and a Maintenance and Parts Manual.	Yes	

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APPENDIX III - COORDINATION

The following agencies participated in the review of the test report:

US Army Aviation School

US Army Combat Developments Command Aviation Agency

III-1

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APPENDIX IV - DISTRIBUTION LIST

REPORT OF USATECOM PROJECT NO. 4-5-1001-01

<u>Agency</u>	<u>No. Copies</u>
Commanding General US Army Aviation Materiel Command ATTN: SMOSM-EP St. Louis, Missouri 63166	10
Commanding General US Army Materiel Command ATTN: AMCMR-MC Washington, D.C. 20315	2
Commanding General US Continental Army Command ATTN: Colonel Greer Fort Monroe, Virginia	2
Commanding General US Army Test and Evaluation Command ATTN: AMSTE-BG Aberdeen Proving Ground, Maryland 21005	2
Commanding General US Army Mobility Command ATTN: AMSMO-M Warren, Michigan	2

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AD _____ Accession No. _____
US Army Aviation Test Board, Ft. Rucker, Alabama. Final Report of
USATECOM Project No. 4-5-1001-01, Military Potential Test of the
Model 310I Fixed-Wing Instrument Trainer, 30 November 1964. DA
Project No. None. 42 pp., 7 illus. FOR OFFICIAL USE ONLY report.
The Military Potential Test of the Model 310I Fixed-Wing Instrument
Trainer was conducted by the US Army Aviation Test Board during the
period 1 September to 21 October 1964 at Fort Rucker, Alabama.
Flight under actual and simulated instrument conditions and flight
demonstrations to personnel representing the US Army Aviation Center
and the US Army Aviation School were conducted during the test period.
It was found that the Model 310I as changed by the technical proposal
will not meet all of the requirements contained in the Model Specifica-
tion. It was recommended that a confirmatory test be performed on
the initial production airplane if the Model 310I airplane is selected as
a fixed-wing instrument trainer.

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